EXPLAINED

A GUIDE FOR EXECUTIVES

Accenture Applied Intelligence

A TECHNOLOGY REVOLUTION LIKE NO OTHER



Everyone is talking about artificial intelligence (AI). From boardrooms to factory floors, from call centres to logistics fleets, and from governments to venture capitalists, artificial intelligence is suddenly the hottest topic in town.

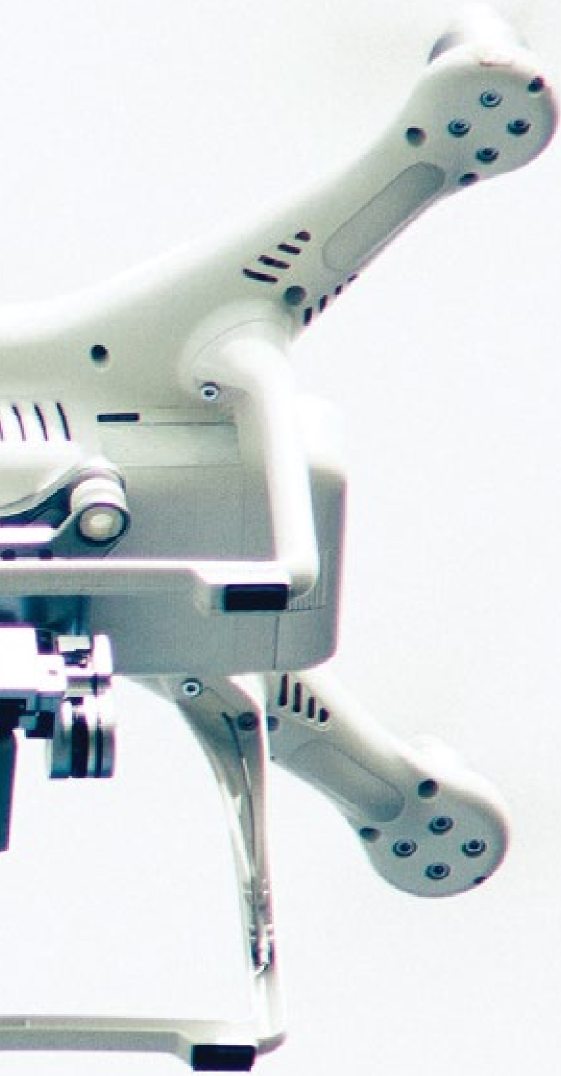
But is AI anything more than the latest technology buzzword? The answer is yes. In fact, AI might just be the single biggest technology revolution the world has ever seen.

This guide will explain why.



Over the past twenty years or so, business has faced its fair share of disruption. Indeed, digital disruption is thought to have put more than half of Fortune 500 companies out of business since 2000.[1] And now AI is set to compound that disruption by shifting it up to the next gear.

That's because AI is what economists call a general-purpose technology. And these general-purpose technologies are a big deal: think electricity and the internal combustion engine. Their significance lies in the fact that they cause disruption not only through direct contribution to society, but also through the way their spill-over effects enables a vast range of complementary innovations. Electricity made possible factory electrification, telegraphic communication, and all that followed. And the internal combustion engine gave rise to the automobile, the aeroplane, and modern transportation and logistics networks. AI will impact society on a similar scale.



AI has become viable today thanks to the combinatorial effect of a series of fast-moving technology trends (see page 34 for the evolution of AI). Those trends are lowering barriers to entry across a wide range of industries. A new wave of AI-first businesses is flowing into the market, shifting the competitive landscape for incumbents. These new businesses are nimbler, unencumbered by legacy technology systems, distribution channels, or the need for workforce transformations.

"AI is the ultimate breakthrough technology."

Satya Nadella, CEO, Microsoft

Private investment is booming. Venture capital investment in AI for the first nine months of 2017 totalled $7.6 billion[2] (compared with $5.4 billion for the whole of 2016). The registration of AI patents is at an all-time high, five times the figure in 2006.[3] And in the US, the number of AI start-ups has increased by twenty times in just four years.

Governments and academic institutions are also looking to ensure their economies maximise the benefits of the technology. In the UK, a major government-commissioned report estimated AI could unlock £630 billion for the country's economy.[4] Five leading UK universities have also come together to create the Alan Turing Institute, the UK's national institute for data science and artificial intelligence. And a new £30 million National Innovation Centre for Data is being established at Newcastle University, funded by both government and academia.

It all adds up to a fast-paced, ever-shifting competitive, investment, and research landscape. The bottom line: AI is here, and every executive must sit up and take notice.



By 2020, the AI market will surpass $40 billion.[5]

Constellation Research

WHAT IS AI EXACTLY?



So you’ve heard all about AI, and you know it’s a big deal. But what is it exactly? Answering that question isn’t as straightforward as it might seem. In fact, there’s no single accepted definition of “artificial intelligence”. And that’s because AI as we know it isn’t really a technology in its own right at all.

In reality, it’s a collection of different technologies that can be brought together to enable machines to act with what appears to be human-like levels of intelligence.

Rather than add to the growing list of attemps to definitely describe AI, we prefer to think of the technology as a framework of capabilities. This is undoubtedly the best way to understand what AI is, and to get a sense of the technologies that underlie it. Our framework is centred around the **principal things that AI enables a machine to do**.

There are four:

SENSE. AI lets a machine perceive the world around it by acquiring and processing images, sounds, speech, text, and other data.

COMPREHEND. AI enables a machine to understand the information it collects by recognising patterns. Much as humans interpret information by understanding the patterns presented and their context, though it does not derive true “meaning”.

ACT. AI enables a machine to take actions in the physical or digital world based on that comprehension.

LEARN. AI enables a machine to continuously optimise its performance by learning from the success or failure of those actions.

WHAT'S IN A NAME?
COGNITIVE COMPUTING AND AI

Cognitive computing is a term widely used by AI practitioners. So what is it? And how is it different from AI? Unfortunately, just as AI has not widely accepted definition, cognitive computing can mean different things to different people. That said, "cognitive" in this sense can, for the most part, be treated as referring to an AI's perceptive capabilities – an AI's ability to sense and comprehend its environment.

The power of machine learning

An AI's ability to learn is fundamental. Indeed, being able to decide which actions are required to complete a task by analysing data, rather than being explicitly coded to act in a pre-defined way, is arguably what makes a system "intelligent" and differentiates AI from other forms of automation.

And when the best AI systems are set the task of learning for themselves, the results can be extraordinary. AlphaGo, the AI developed by Google DeepMind, became the first computer program to defeat a professional human player at the highly-complex board game Go.[6] AlphaGo was taught the rules of play, and then shown thousands of different human vs. human games so that it could discern the winning strategies by itself. The result: victory over the legendary world Go champion, Lee Sedol.

But even that wasn't the end of DeepMind's Go success. The company subsequently developed a second, even more powerful, version of AlphaGo - AlphaGo Zero[7], which taught itself winning strategies **simply by playing games against itself** – with no need to observe human players at all. Moreover, the latest iteration of the AI, AlphaZero, has gone even further. AlphaZero proved it could learn chess



by playing games against itself, surpassing human levels of skill in just four hours. The really interesting part of this feat was that AlphaZero wasn't specifically designed to play chess at all. Indeed, Jonathan Schaeffer[8], professor of computer science at the University of Alberta, and an expert in chess systems, believes this may be the very reason it has been able to develop unconventional strategies for winning. In this way, AlphaZero represents an important step away from narrow AI towards general AI (for an explanation of the difference between narrow and general AI, see page 22).

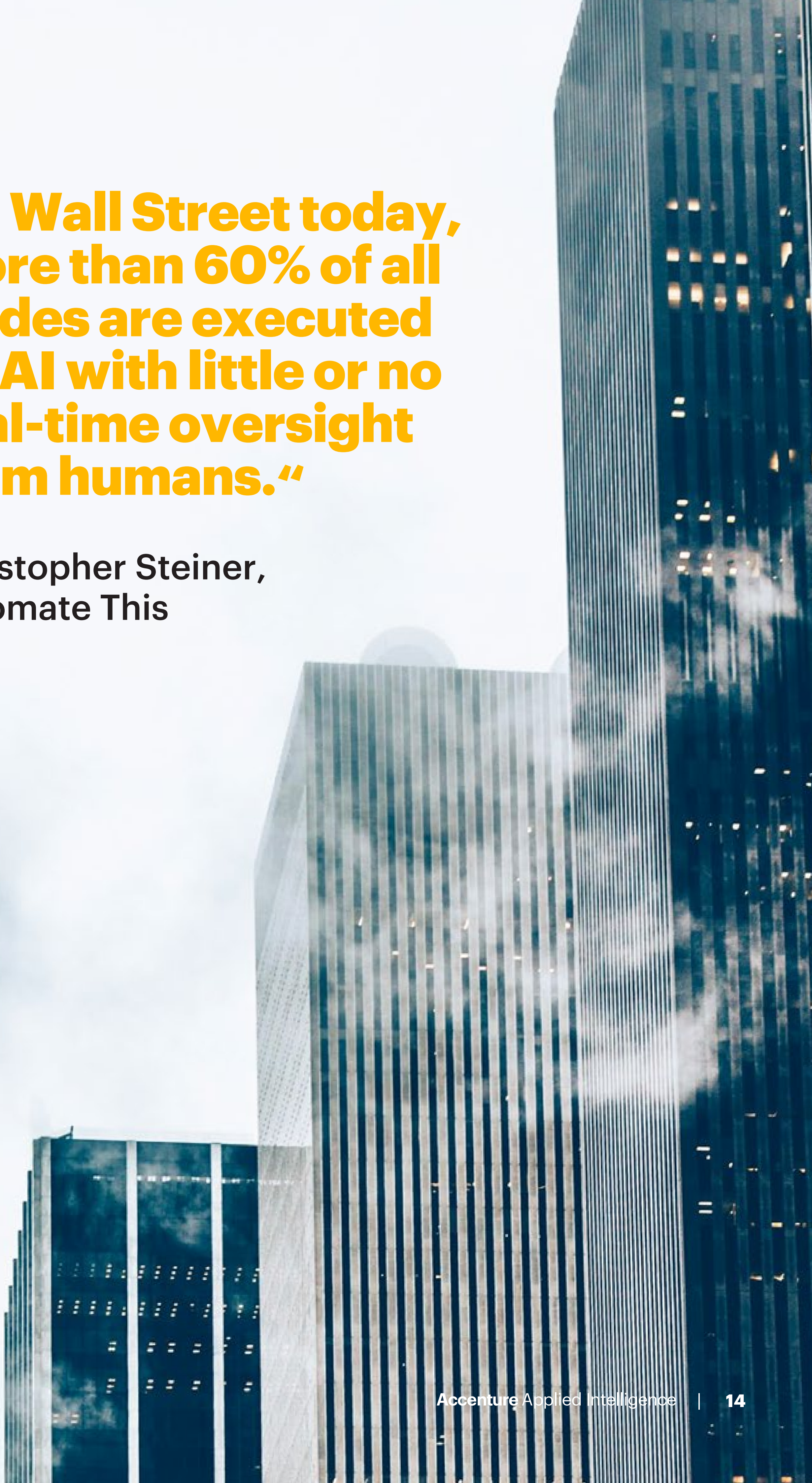
This is what we call **machine learning**. And the reason it's so powerful, as Brynjolfsson and McAfee have observed[9], is quite simple. While we humans are fantastically skilled at performing any number of different activities, we don't always know exactly how we do what we do. So, for example, we might find recognising another person's face very easy. But we don't fully understand the precise physiological mechanisms that let it happen. And that makes it very difficult to directly code the capability into a machine.



Machine learning, on the other hand, lets a machine learn to do it all by itself. Indeed, one of the core strengths of machine learning is identifying patterns in very large amounts of data.

“On Wall Street today, more than 60% of all trades are executed by AI with little or no real-time oversight from humans.“

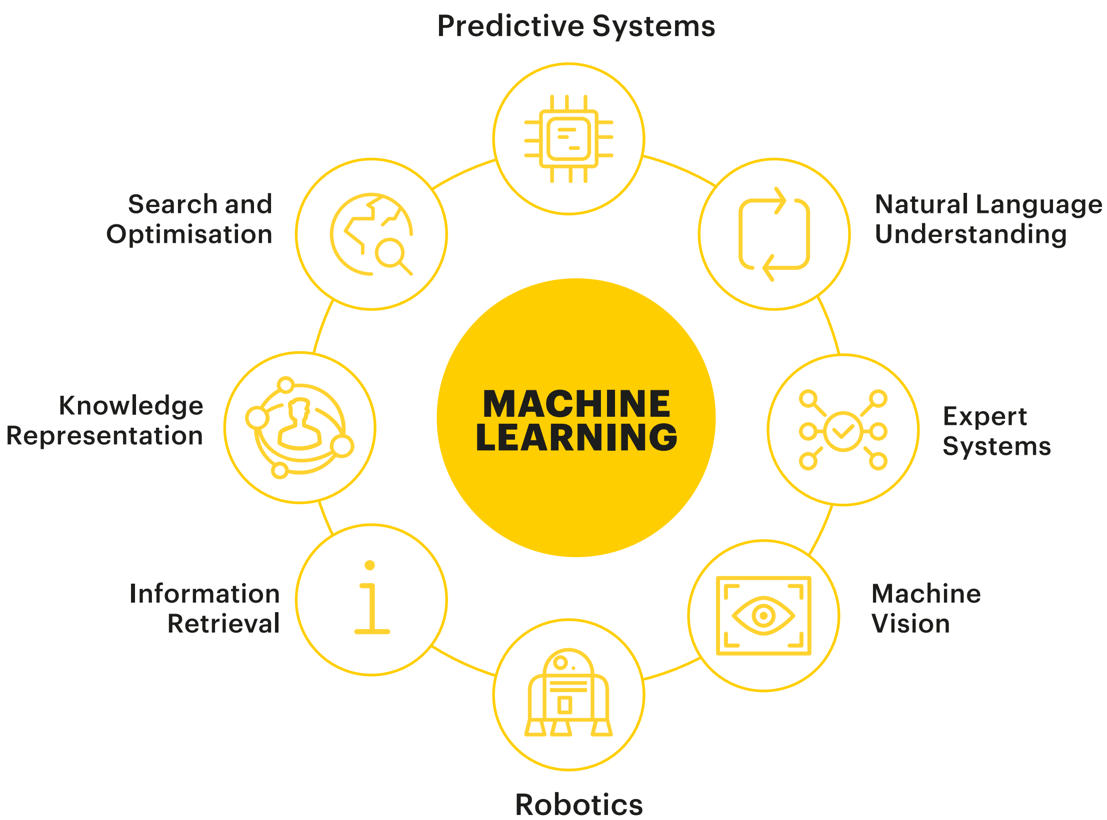
Christopher Steiner,
Automate This



A constellation of technologies

Machine learning lies at the core of AI systems. Its capability to learn from raw data powers the visible manifestations of AI that are becoming ever more prevalent today. So, whether it's predictive systems that can forecast what's likely to happen, natural language processing that can comprehend speech and text in close to real time, machine vision that can understand visual inputs with extraordinary accuracy, or optimising search and information retrieval, it's all based on machine learning.

Figure 1 - Machine learning capabilities



One critical advantage machine learning has over other techniques is its tolerance of "dirty" data. That is, data containing duplicate records, badly parsed fields, or incomplete, incorrect, or outdated information. These issues are a significant problem for businesses: most executives will recognise all too well that dealing with dirty data can be the bane of their professional lives.

Machine learning's flexibility – it's ability to learn and improve over time – means dirty data can be processed with far greater accuracy. It also means that the technology scales very well, something that becomes ever more important in our current age exploding data volumes.

More than 85% of customer interactions will be managed without a human by 2020.[10]

Gartner



The different ways a machine can learn

One of the real strengths of machine learning is that there are different types of learning algorithms which can be used, including supervised, unsupervised, and reinforcement.

SUPERVISED LEARNING. This kind of algorithm takes a labelled data set (data that has been organised and described), deduces the salient features that characterise each label, and learns to recognise those features in new data. So, for example, you might show the algorithm a large number of labelled images of cats, and it would then learn how to recognise a cat and spot one in any number of other, completely different pictures.

UNSUPERVISED LEARNING. This kind of algorithm requires no predefined labels in the data it uses. It takes an unlabelled data set, finds similarities and anomalies between different entries within that data set, and categorises them into its own groupings. So, you might show the algorithm a large number of unlabelled images containing, say, cats and dogs, and it would sort images with similar characteristics into different groups without knowing that one contained "cats" and the other "dogs".

REINFORCEMENT LEARNING. This kind of algorithm works by trial and error, using a feedback loop of "rewards" and "punishments". So, when the algorithm is fed a data set, it treats the environment like a game, and is told whether it has won or lost each time it performs an action. This way, it builds up a picture of the "moves" that result in success, and those that don't. DeepMind's AlphaGo and AlphaZero (page 11) are good examples of the power of reinforcement learning.

Figure 2 - Puppy or bagel?



PUPPY OR BAGEL?

How hard is it to tell an animal from an item of food? Sometimes, much more difficult than you might think. One of the big trends storming the internet is all about the odd similarities between certain pets and snacks. Take the puppies and bagels in the image opposite, for instance. At first glance, it can be surprisingly challenging for a human to tell which is which. Not so for an AI. Pass the images through an image recognition API and you'll find the AI can distinguish the food from the pets with impressive accuracy.[11]

The artificial brain

So, how does machine learning actually work? Sitting behind many of the extraordinary advances in recent years lies a very advanced and elegant form of computing system – one inspired by the functioning of the animal brain itself. These systems are called **neural networks**, and they underpin much of today's cutting-edge work in AI.

A neural network comprises an interconnected set of "nodes" which mimic the network of neurons in a biological brain. Each node receives an input, changes its internal state, and produces an output accordingly. That output then forms the input for other nodes, and so on. This complex arrangement enables a very powerful form of computing called deep learning.

Deep learning uses multiple layers of filters to learn about the significant features of data in a data set. It's used for examples, in both image and speech recognition. Using a neural network, the output of each filter provides the input for the next, where each filter operates at a different level of abstraction.

In this way, deep learning systems can handle much larger data sets than alternative approaches.

Facial recognition

Deep learning neural networks use layers of increasingly complex rules to categorise complicated shapes such as faces.[12]

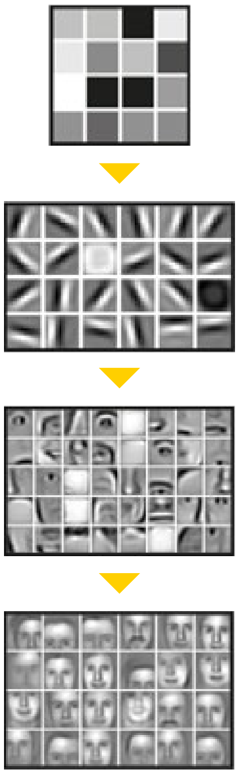
Figure 3 - How a neural network recognises objects

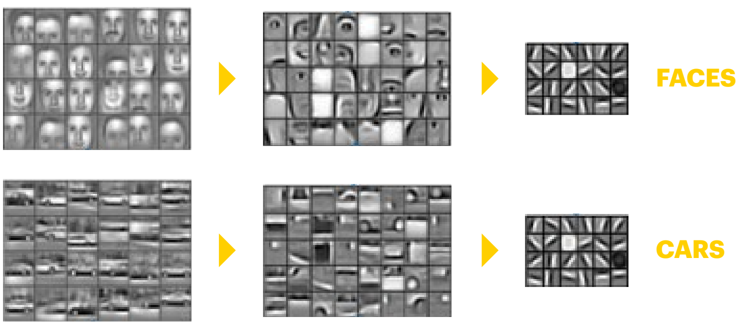
LAYER 1
The computer identifies pixels of light and dark.

LAYER 2
The computer learns to identify edges and simple shapes.

LAYER 3
The computer learns to identify more complex shapes and objects.

LAYER 4
The computer learns which shapes and objects can be used to define a human face.





WHAT KIND OF INTELLIGENCE ARE WE TALKING ABOUT?

When data scientists and others talk about AI, they often use two categorizations to clarify their meaning. These are **narrow AI vs. general AI and weak AI vs. strong AI.**

WEAK AI

This describes "simulated" thinking. That is, a system which appears to behave intelligently, but doesn't have any kind of consciousness about what it's going. For example, a chatbot might appear to hold a natural conversation, but it has no sense of who it is or why it's talking to you.

NARROW AI

This describes an AI that is limited to a single task or a set number of tasks. For example, the capabilities of IBM's Deep Blue, the chess-playing computer that beat world champion Gary Kasparov in 1997, were limited to playing chess. It wouldn't have been able to win a game of tic-tac-toe – or even know how to play.

STRONG AI

This describes "actual" thinking. That is, behaving intelligently, thinking as a human does, with a conscious, subjective mind. For example, when two humans converse, they most likely know exactly who they are, what they're doing, and why.

GENERAL AI

This describes an AI which can be used to complete a wide range of tasks in a wide range of environments. As such, it's much closer to human intelligence. Google DeepMind used reinforcement learning to develop an AI that learned to play a whole range of different games requiring different skills. The AI achieved human-like levels of performance at 29 classic Atari video games using only the on-screen pixels as its data input.[13]

SUPERINTELLIGENCE

The term "superintelligence" is often used to refer to general and strong AI at the point at which it surpasses human intelligence, if it ever does.

“Instead of trying to produce a programme to simulate the adult mind, why not rather try to produce one which simulates the child’s? If this were then subjected to an appropriate course of education one would obtain the adult brain.“

Alan Turing, 1950



Time to train

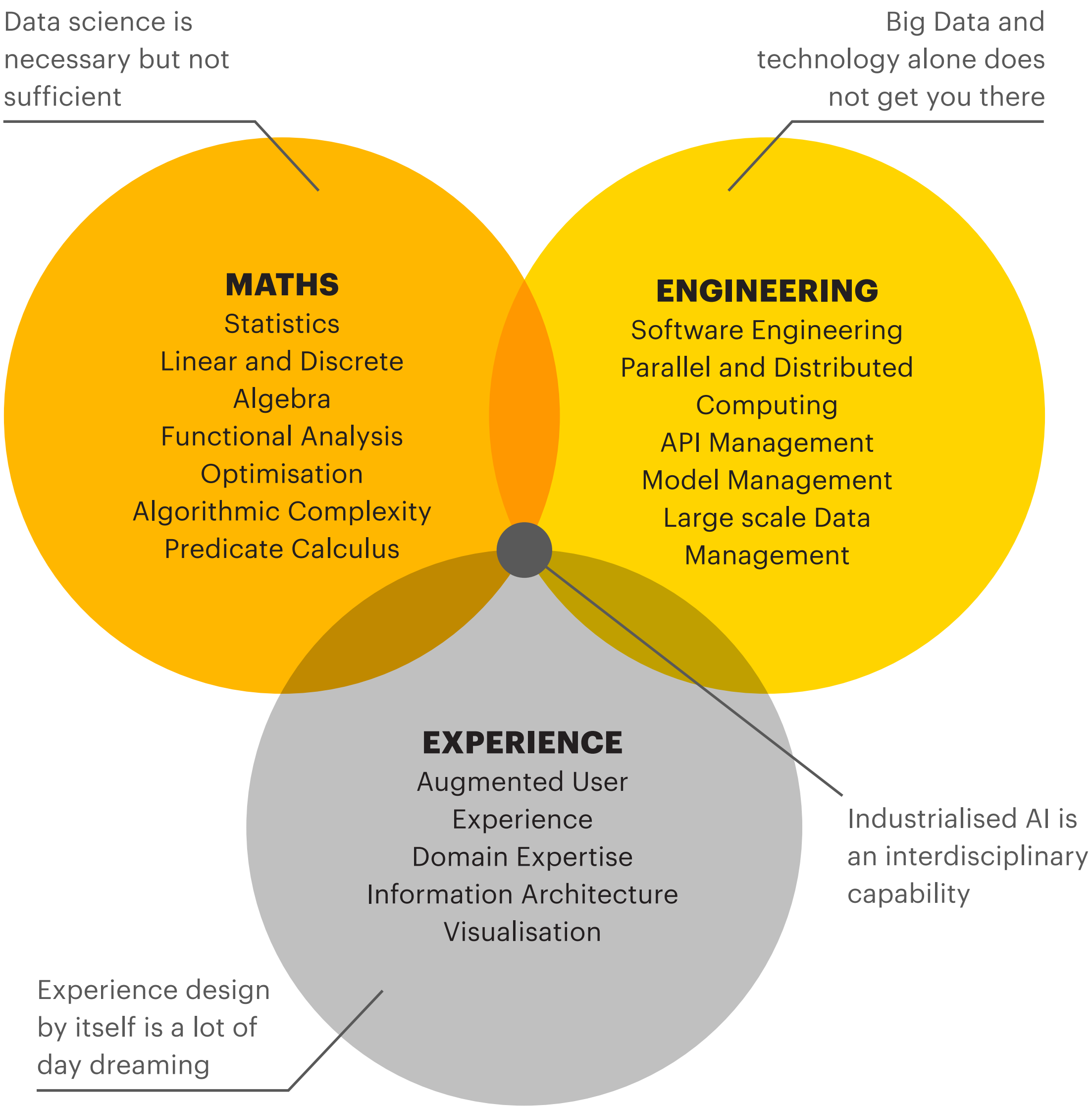
The “learning” part of a machine learning process is, perhaps unsurprisingly, critical to the whole concept. Much as a human brain must learn throughout childhood to understand and process the information it receives, so must a machine learning algorithm or model be trained to comprehend its environment.

When companies get the training wrong, the results can be embarrassing – or worse. Microsoft’s now infamous chatbot Tay[14] was an experiment in machine learning through social media interactions. The AI was designed to learn to hold a natural-sounding conversation by speaking with other Twitter users. But she had to be quickly decommissioned when a collection of trolls and racially biased comments capitalised on her lack of filters and taught her a series of racial slurs and white-supremacist propaganda. Microsoft’s experience starkly highlights the need for strong governance and controls in deploying AI systems (for more on the governance questions that AI raises, see page 66).



Getting the training right takes more than just advanced maths. Industrialised machine learning is an interdisciplinary capability. It takes a blend of data science, engineering, and user experience design with **relevant domain knowledge**. None of these capabilities on their own will suffice.

Figure 4 - Industrialised AI as an interdisciplinary capability



Fitting analytics into the picture

So where does analytics fit into all this? Perhaps the question should be: how does AI fit into analytics? If we think of analytics as the field of analysing data to improve decision making, we can see how machine learning, along with other statistical analyses, plugs in to the process. After all, the goal of analytics is to derive insights from data – which is much the same as the goal of machine learning.

Analytics, and any machine learning algorithms that support it, can have different levels of sophistication depending on the degree of insight required. So, at the simpler end of the scale are so-called "descriptive analytics" which analyse historical data to understand what happened and why. Then come "predictive analytics" which use data to predict what will happen in the future. Finally, at the far end of the scale, come "prescriptive analytics" which not only forecast what will happen, but tell you what you need to do about it.

By 2020, insights-driven businesses will take $1.2 trillion per annum from their less-informed peers.[15]

Forrester

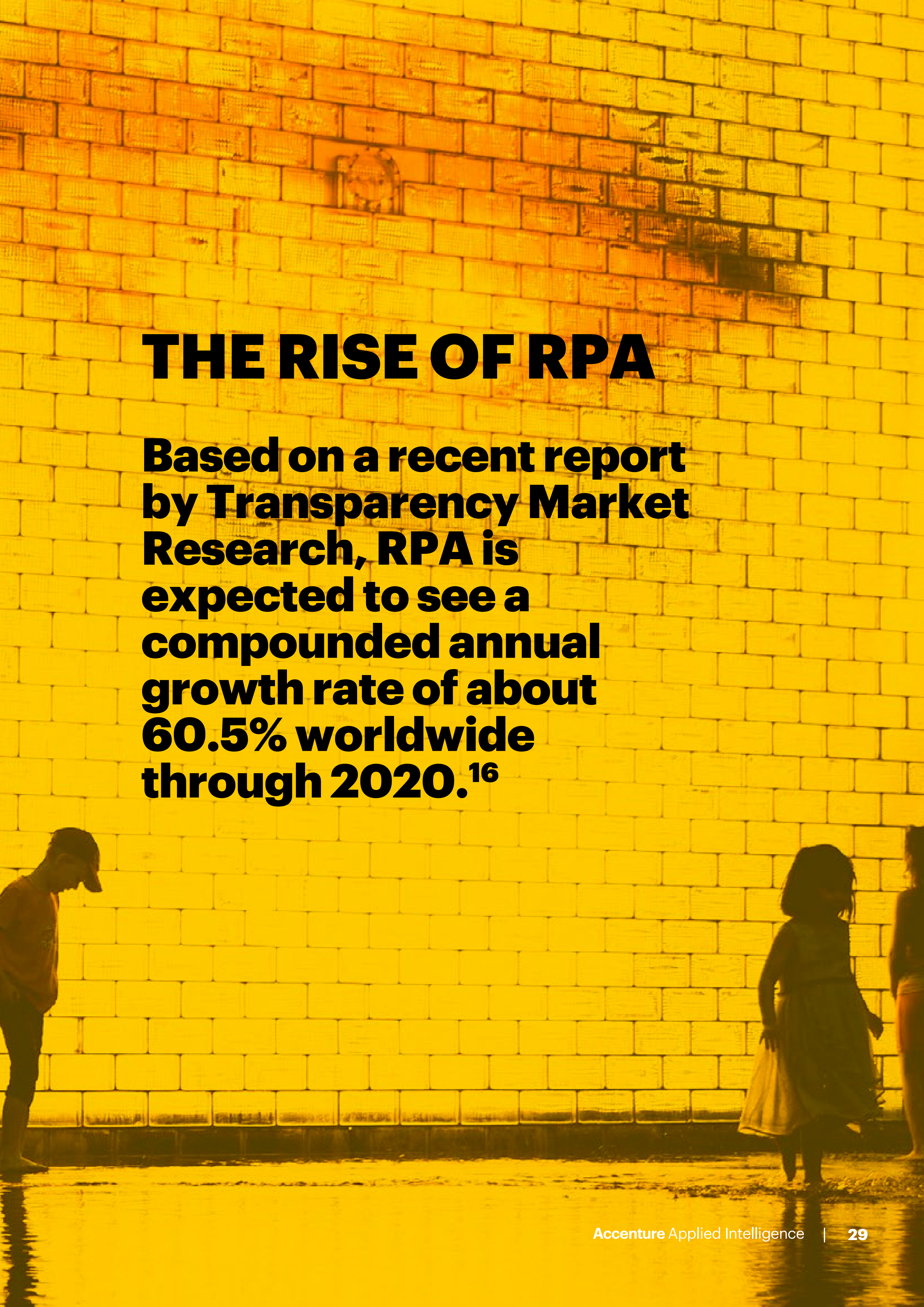
AI, robot

When it comes to thinking about AI, robots and robotics are often front of mind. In the public imagination, that can mean anything from Kubrick's HAL, to Asimov's mechanical men, to Honda's Asimo.

In a business context, it can mean both the automation of manufacturing or service processes using mechanical robots – think car assembly lines – and, increasingly, the automation of administrative or service processes comprising both digital and manual inputs using Robotic Process Automation (RPA).

Strictly speaking, because RPA is designed for processes that never vary it doesn't require any "intelligence" at all. So, for example, if a business process involves a person manually transferring data in a standard form from one system (for example a piece of paper) to another, the process can be easily automated through RPA with a form of keystroke emulation. Accenture applied RPA to a large manufacturing client's invoice processing. **The result: a 70% elapsed time saving; a 30% productivity benefit; and 100% accuracy.**

That said, AI techniques are now being increasingly used in the emerging field of "cognitive RPA". This enables a process with a degree of variation to be automated, and thus vastly increases the scope of RPA. That can include, for example, using machine learning to train a machine to recognise text in an image (known as optical character recognition).



THE RISE OF RPA

Based on a recent report by Transparency Market Research, RPA is expected to see a compounded annual growth rate of about 60.5% worldwide through 2020.[16]

Indeed, we at Accenture often recommend RPA as an ideal starting point for a business that wants to begin an AI journey. That's because successfully using RPA means first acquiring a detailed understanding of the process to be automated. And that's also the first step in designing a broader and more sophisticated AI-powered automated solution. It's also essential in ensuring that existing, sometimes sub-optimal, processes are not simply emulated in digital form, but are re-engineered to exploit AI to the fullest extent possible.

An important point to note: RPA and cognitive RPA do more than simply cut costs. They also bring new levels of consistency and speed to a process, as well as offering 24/7 availability and the capacity to scale the process up and down in line with demand. And it should always be remembered that RPA replaces tasks, not people. Many organisations who use RPA redeploy their workforces to activities that add more value to the business – and are more interesting to boot!

We know this because we've done it ourselves. For all of the 17,000 jobs we've automated at Accenture, we've successfully redeployed our colleagues in other areas of our business. Indeed, a 2017 Gallup survey[17] the US suggested that only 13% of workers are worried about automation eliminating their jobs. Nevertheless, the impact of RPA and AI on the workforce is a sensitive issue which calls for careful management (for more on the responsible use of AI, see page 63).

“RPA has changed the way we structure and allocate work, allowing us to focus on improvement initiatives... By automating routine tasks, we allow our skilled employees to focus on the more interesting and challenging parts of their jobs, which has the dual benefit of satisfied employees and improved customer experience. Accenture has been with us from the beginning, helping us in the exploratory phases of RPA right through to the implementation.“

Kristian Kjernsmo, Managing Director,
Circle K Business Centre at Circle K Europe



THIS TIME IT'S DIFFERENT

AI is far from a new idea, it's true. The term "artificial intelligence" was coined as long ago as 1956.[18] And the history of the technology's development has been characterised by waves of optimism followed by disappointment and periods of inertia (these have even been dubbed 'AI winters'). Each previous breakthrough has only ever partly lived up to the hype it generated, and none have managed to kick-start the technology into the mainstream.

So what's different this time?

Figure 5 - The history of AI

1940-1956: The Birth of AI

- **1950** – Alan Turing created the Turing Test.
- **1956** – Conference held at Dartmouth College where the term Artificial Intelligence was coined.

1956-1974: The Golden Years

- **1958** – Samuel's checkers program used Machine Learning to beat human players.
- **1959**
- **1961** – IBM's Shoebox performed arithmetic by voice command.
- **1966** – Shakey became the first mobile robot "aware" of its surroundings.
- **1966** – ELIZA, an artificial conversational "therapist" created.

1974-1980: AI Winter

1980-1987: AI Boom

- Boom of Expert Machines in industry like the R1/XCON to help sales representatives avoid errors in product suggestions.

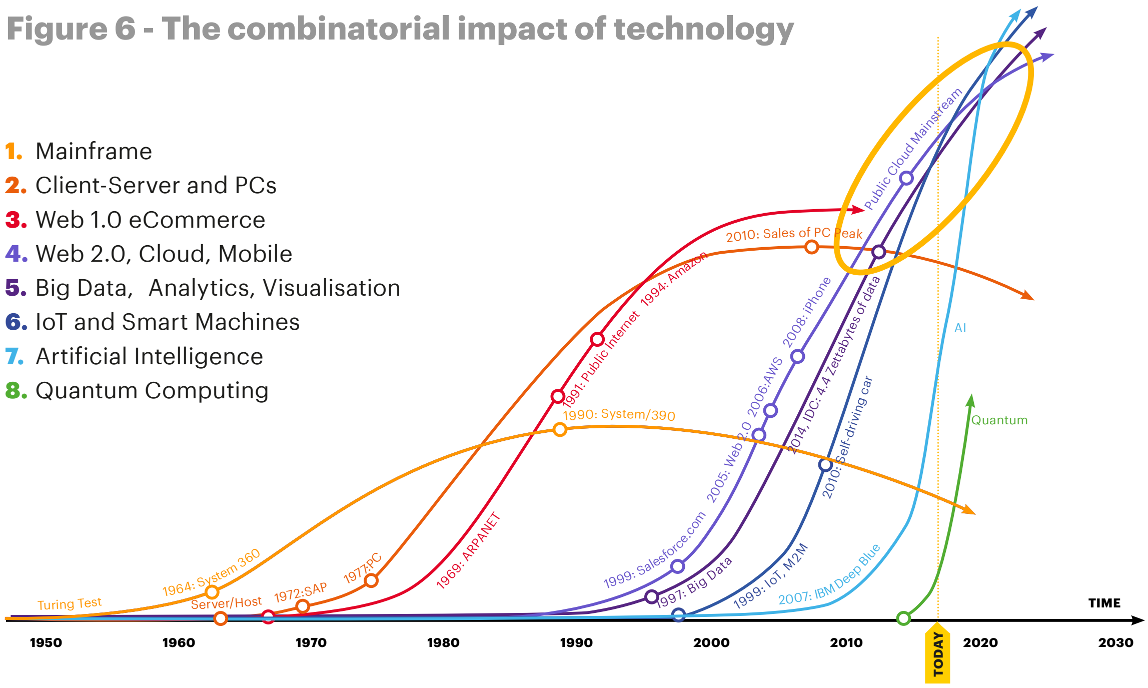
1987-1994: Second Winter

1994-present: Modern Age

- **1994** – Two robotic cars drove long distance on the highway.
- **1997** – IBM's Deep Blue defeated chess champion.
- **2000** – Kismet, a social machine capable of expressing emotions is introduced.
- **2004** – Honda Asimo, a personal robot, is released.
- **2011** – IBM's Watson beats best Jeopardy!
- **2016** – Introduction of Virtual Agents with Siri, Google Now, and the release of IPSoft's Amelia.
- **2017** – Google's AutoML lets AI generate AI.
- **2018** – The guide was published.

The big change today is that we're in an unprecedented period of technology innovation across so many different fields. Today's AI applications can make use of virtually unlimited processing power in the cloud. They can also exploit a growing trend for custom-designing computer chips for specific tasks, especially in analytics, which is enabling even greater levels of computational efficiency and speed. Consider, for example, the vastly increased processing power that comes from using Graphics Processing Units (GPUs) in place of Central Processing Units (CPUs). But Google has taken it one step further, the Tensor Processing Unit (TPU) delivering 30-80 times higher performance-per-watt that contemporary CPUs and GPUs.[19]

Figure 6 - The combinatorial impact of technology



When you add the decreasing cost of storage[20] to the mix (down from $0.5 million a gigabyte in 1980 to 3 cents a gigabyte in 2015), plus the exponential growth in data volumes with which we can train AIs, together with the emergence of open source platforms and frameworks, you've got a uniquely potent combination of technologies and capabilities. It all adds up to a very powerful foundation to give AI its critical mass for mainstream adoption.

Virtually all the leading technology giants around the world – Google, Amazon, Facebook, Microsoft, Baidu, Alibaba, and Tencent – are sharply focused on AI. Other entrepreneurs and investors are equally keen. More than half of European start-ups are focused on AI, and investments in AI businesses are typically 20 to 30% higher than those in other businesses.[21]

That's not to say everyone agrees on precisely when AI will reach its tipping point. Nor on whether we'll see general AI (as opposed to narrow AI) any time soon. On the one hand, a survey of 350 experts by the Universities of Oxford and Stanford[22], concluded that there is a 50% chance of machines outperforming humans in all tasks within 45 years. On the other hand, a quarter of the eminent AI researchers surveyed by Etzioni in 2016 said they thought superintelligence would never materialise at all.[23]

"Artificial intelligence would be the ultimate version of Google. The ultimate search engine that would understand everything on the web. It would undertand exactly what you wanted, and it would give you the right thing. We're nowhere near doing that now. However, we can get incrementally closer to that, and that is basically what we work on."

Larry Page, 2000



Your competitors are probably already using AI today

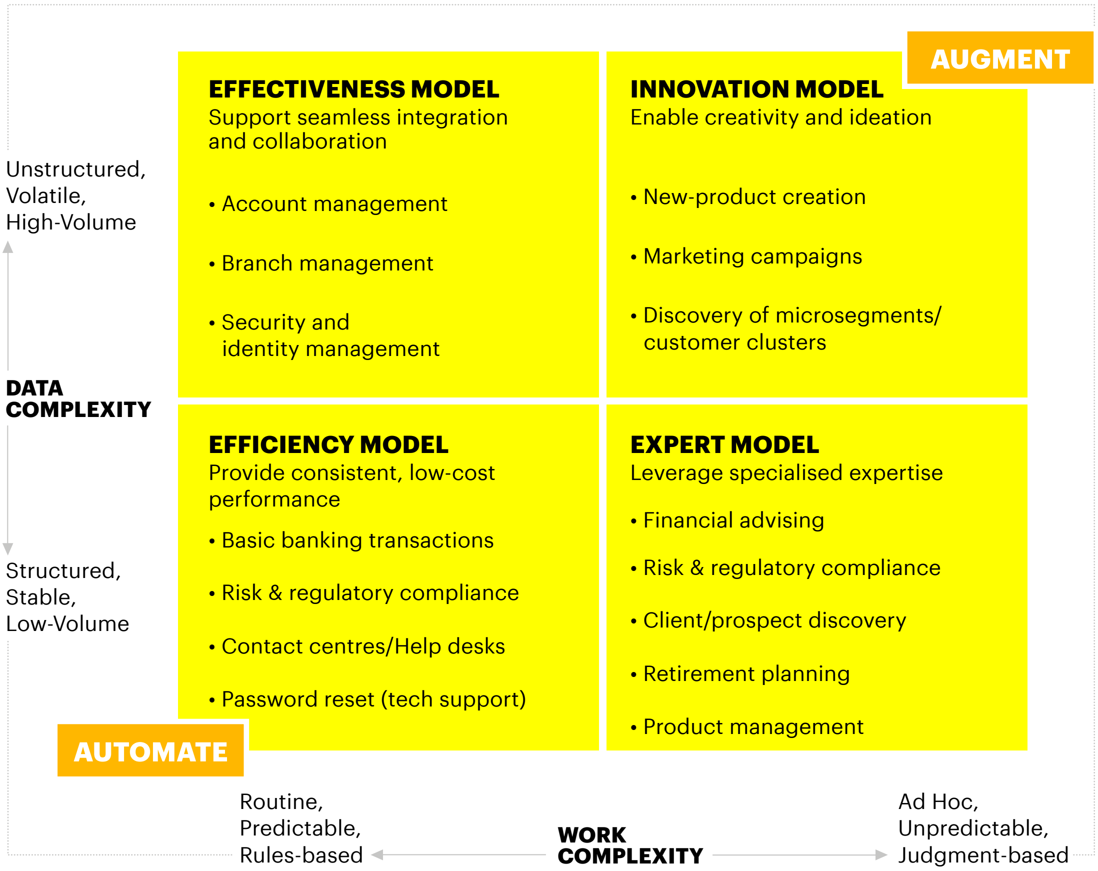
So we don't have general AI yet. But, with the underlying technologies accelerating at breakneck pace, narrow AIs are already doing remarkable things in real-world business applications.

As organisations continue to ramp up their use of AI, the complexity of both the data and the work that it can handle will only increase. To understand how this might play out in a business context, it can be helpful to view the possible applications of the technology through the following framework (here illustrated fort he financial services industry). The framework maps four different models for approaching AI – efficiency; effectiveness; expert; innovation – against the degree of data and work complexity involved.

In our work with our clients, we already see evidence of AI being scaled and industrialised. Many organisations have been running pilots over the last few years to test how AI might impact their people, their processes, and their products. Now, we expect those organisations to start scaling their pilots across their enterprises. As many as three-quarters of executives say that some kind of AI will be "actively implemented" in their organisation within three years.[24]

All in all, the message is clear: AI is ready. And it's a big deal.

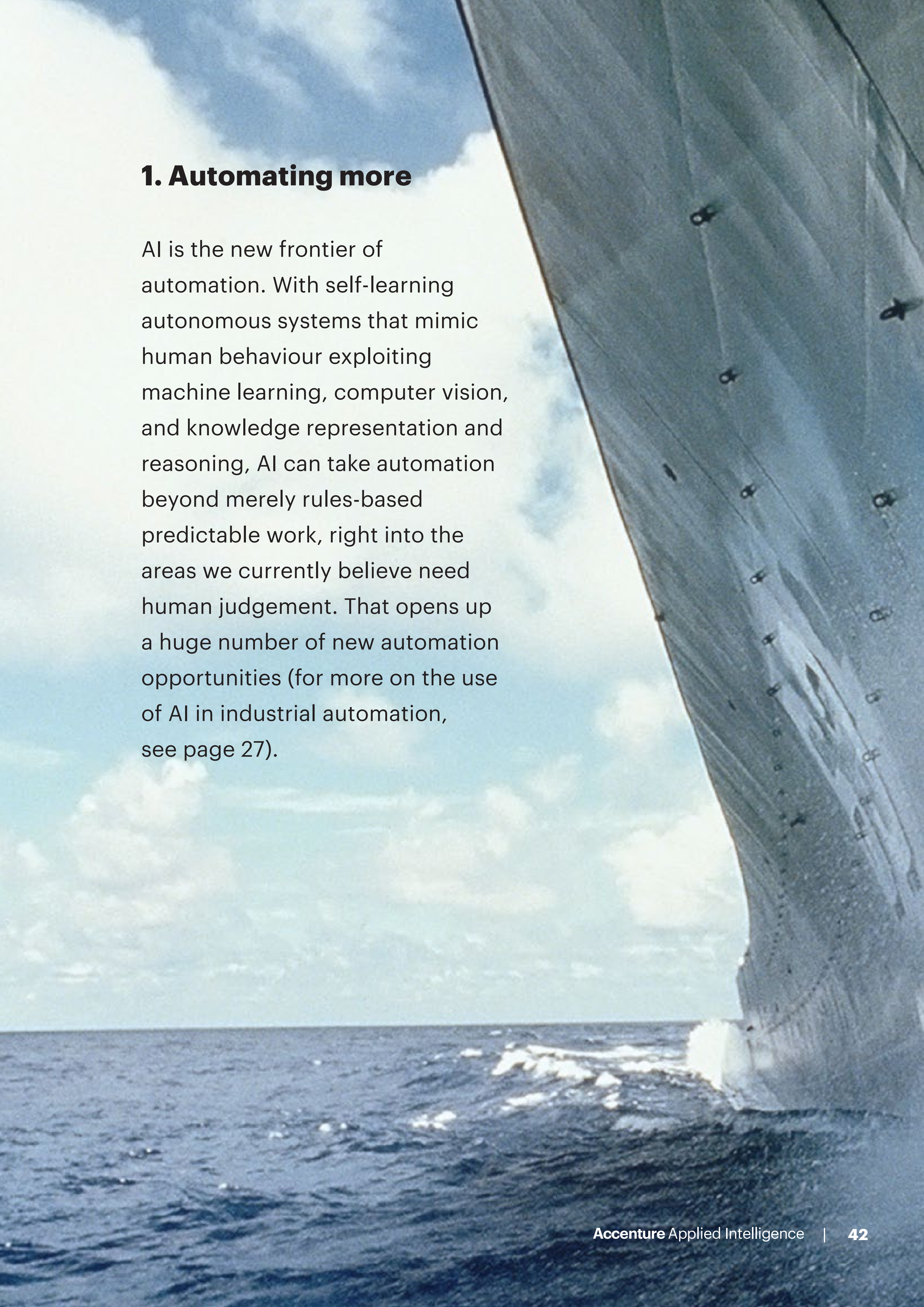
Figure 7 - A framework for understanding AI's potential applications



PUTTING IT INTO PRACTICE



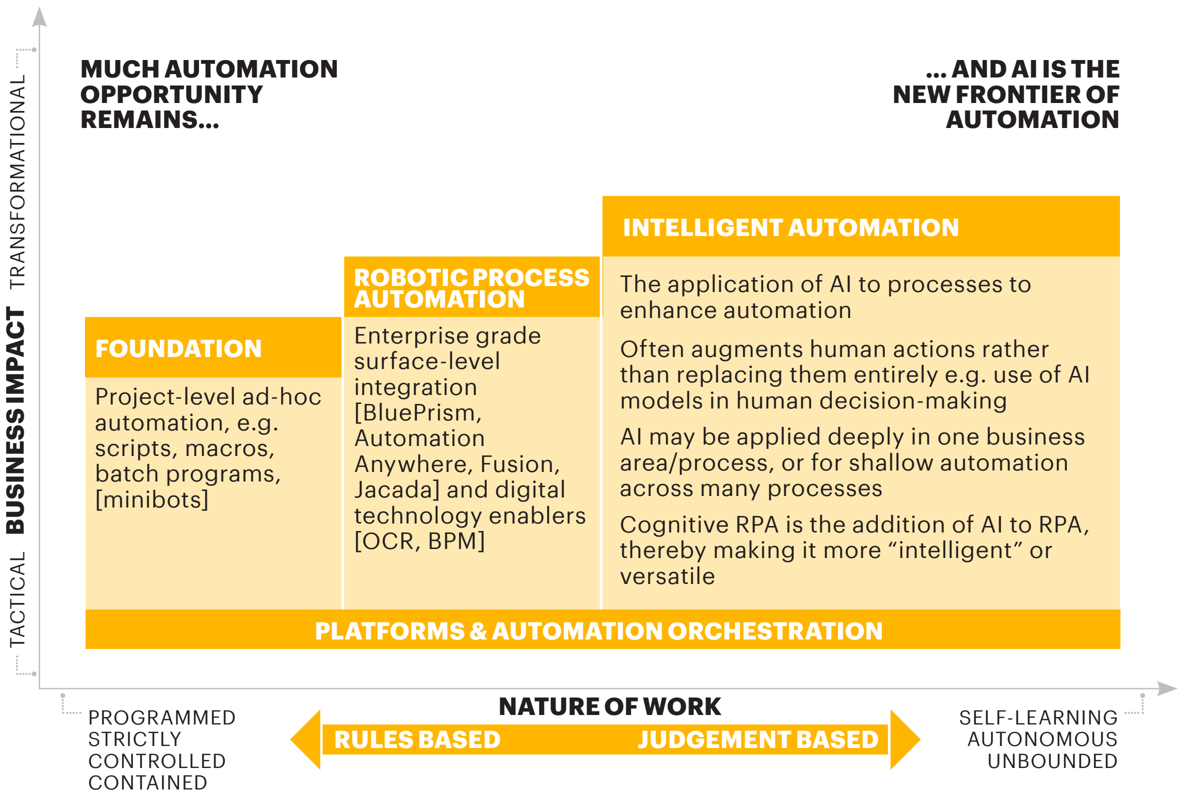
Approached in the right way, AI will be a new driver of economic value for your business. But which way is the right way? In such a fast-moving field, it can be hard to see the wood for the trees. The first step is to understand the opportunity that AI presents. By breaking it down into three avenues, you can get a much clearer sense of the route you should be taking. So, that means you should be thinking about how to use AI to shift automation up a gear, about how to augment what you do and the way you do it, and about how AI innovation might diffuse through your business and beyond.



1. Automating more

AI is the new frontier of automation. With self-learning autonomous systems that mimic human behaviour exploiting machine learning, computer vision, and knowledge representation and reasoning, AI can take automation beyond merely rules-based predictable work, right into the areas we currently believe need human judgement. That opens up a huge number of new automation opportunities (for more on the use of AI in industrial automation, see page 27).

Figure 8 - The intelligent automation frontier



ROBOT FOR RECYCLING

AMP Robotics has created a robotic system called Cortex which uses computer vision to rapidly pick recyclable materials from a conveyor belt of waste products. The system is driven by an AI, called Neuron, capable of distinguishing materials that can be recycled from those that can't – even if they're dirty or piled up with other materials – using a video stream.[25]

2. Augmenting how you work

AI brings new levels of efficiency to the use of resources. In practice, that means two things. First, augmenting human workers' judgement. And second, enhancing customer experience.

#1 Working smarter. When it comes to augmenting worker judgement, machine learning is capable of extracting more meaning from very large and highly complex data sets than a human ever could. An AI can thus see patterns, similarities, and anomalies, where human experts see none. Consider cancer detection, for example. Human specialists can

recognise several hundred malignant patterns in a cancer scan, whereas an AI can recognise thousands.

Researchers at the University of Nottingham have already created an AI that can predict which patients are likely to have a stroke or heart attack within ten years. The AI performed better than the standard methods of prediction (scoring between 0.745 and 0.764 out of 1 as against 0.728 for the standard method).[26]

These are hugely impressive strides forward. But they shouldn't be taken as a sign that human expertise will be superseded any time soon. The very best results are still achieved when human experts work together with AI, each bringing the best of their unique capabilities to bear on a problem.

4 out of 5 executives (81%) agree within the next two years, AI will work next to humans in their organisations, as a co-worker, collaborator and trusted advisor.[27]

Accenture Technology Vision, 2018

#2 Better experiences for customers. Using AI, and particularly the cognitive aspects of the technology, a business can vastly improve the way it interacts with its customers. That could mean using digital assistants and chatbots to converse with customers 24/7 through social media and digital platforms. Or it could mean making personalised product or service recommendations on an e-commerce site.

When South American airline Avianca wanted to enhance the travel experience of its 28 million passengers, for example, they quickly settled on the idea of a chatbot assistant.[28] We at Accenture helped them create Carla, a Facebook Messenger chatbot which uses AI to help customers manage their travel arrangements. By holding natural-sounding conversations with Carla on a messaging platform they're already familiar with, Avianca's customers have a quick and intuitive way to check in, review itineraries and flight status, and get weather and other updates from the airline – with no waiting on the phone for an advisor.

Moreover, creating a chatbot or digital assistant like Carla needn't cost the earth or consume a business for months on end. Developing Avianca's chatbot took just six weeks. And almost straightaway it acquired over 20,000 unique users who were holding something like 4,000 conversations with it every month. Carla even managed to cut the average check-in time for Avianca's customers in half.

HUMAN–ROBOT JOURNALISM IS ALREADY HAPPENING

The Press Association and Urbs Media, backed by Google's Digital News Initiative, are putting robots to use in very interesting ways. Their Reporters and Data Robots (RADAR) initiative has created software which sifts through national data sets and inserts localised statistics into stories written by human reporters. The stories, which to date have covered everything from hospital cancellations to problems with social mobility, are then offered to local or regional newspapers for publication. Since a pilot began at the end of November 2017, 20 newspapers have published articles created by the initiative, saving their reporters time and lending more weight to their stories.[29]

CHECKING IN TO YOUR HOTEL WITH A SELFIE



AI's customer experience opportunities don't begin and end with chatbots. Consider the possibilities of facial recognition technology for biometric identification, for example.

Singapore and San Francisco-based GTRIIP[30] have developed a document-free mobile check-in application which uses AI and biometric technology to let hotel guests check-in to their rooms with a fingerprint – or by simply taking a selfie.

3. Diffusing innovation

Innovation begets innovation. The spill-over effects of a radical new technology can cascade through entire economies, changing everything forever, and in ways that were never foreseen. When electricity was first industrialised, who could have imagined the vast energy demands of today's power-hungry world? And when the internal combustion engine was created, who could have conceived of the speed and scale of our interconnected global transport networks?

AI will impact society to a similar degree. Its innovations will diffuse through businesses – and beyond to whole economies. New, as-yet unimagined business models and opportunities will be created. From the automation of tasks we once thought needed human intelligence, to the ability to see patterns in vast amounts of data, to new cognitive human–technology interfaces, this technology will have far-reaching and radical implications for our working and personal lives.

Autonomous electric vehicles, for example, will completely upend our current thinking about transportation. Just a few years ago, driving was an activity thought to be so complex that it would have to remain the preserve of human beings. Now, automated transportation is becoming a reality. And, from automotive companies, to logistics, to petrol sales, to global oil, the direct effects of a shift to autonomous vehicles will be profound. But consider, too, the effects of greatly

enhanced safety on vehicle design, on insurance needs, and on medical and emergency response. Or what about the impact on road network design, parking needs, car dealerships, and petrol taxes? The sheer scale of the societal impact from an AI innovation in just one industry is breath-taking.

One of the revolutionary aspects of AI is its simplicity of use. In other words, humans won't need to adapt to it, or learn a new set of skills to use it, making it perhaps unique in the history of radical technologies. We will be able to interact with AI through simple and natural language, whether by voice or by text, or even through images. The contrast with, say, learning to drive a car, or understanding how to use a PC for the first time, couldn't be starker. This has one very important implication: it means the critical-mass adoption of AI is likely to take hold even faster than previous disruptive technologies.

The World Economic Forum features will help prevent 9% of accidents by 2025 with the potential to save 900,000 lives in the next 10 years.[31]



AI FOR GOOD

Accenture has recently completed a pilot program in the UK, which uses its artificial intelligence platform to help seniors manage their care and daily lives. The technology was developed by Accenture Liquid Studio in London and is tailored for older people living independently.[32]



THE ROBOT SURGEON OPERATING ON LIVE PORCINE TISSUE

In a breakthrough proof of concept for robotic surgery, a Smart Tissue Autonomous Robot (STAR) proved it could stitch up the small intestine of a living pig using its own vision, tools, and intelligence. Intestinal sutures are a particularly challenging task for an autonomous robot, given the soft tissue's deformity and mobility. But, with more consistent and leak-resistant sutures, STAR was able to outperform human surgeons who were given the same task.[33]

Putting it into practice

With a clear view of the opportunities, you're ready to put AI to use in your organisation. First and foremost, that means developing a strategy and a roadmap for your AI journey. That roadmap must encompass both the re-engineering of the affected business processes, and appropriate governance controls. Above all, it must prioritise the high-impact AI initiatives for your business.

An important point: it's vital to start with the business case, not the technology. In other words, think first about what you want to do, not what the technology could do. Only then should you add AI to the mix and analyse where it can add value. That should include assessing the feasibility of using AI, the effort vs. return, and the risks involved. It should also include finding a willing business sponsor to push adoption across your organisation. Because, after all, getting people to change their behaviour is often the hardest part in introducing any radical innovation.

WHAT'S STOPPING SOME COMPANIES FROM USING AI?

For all the undeniable activity, the fact remains that most organisations are yet to begin their AI journeys. And of those that have started, half are still in the pilot or proof of concept stage.[34] So what's stopping them? The reasons are varied, and not dissimilar to those encountered with advanced analytics. For some, it comes down to getting the right talent, prioritising investments, and allaying concerns about security. For others it's about defining compelling business cases, strong enough leadership support, and acquiring more general technology capabilities.

Figure 9 - What are the top three barriers to AI adoption in your organisation?[35]

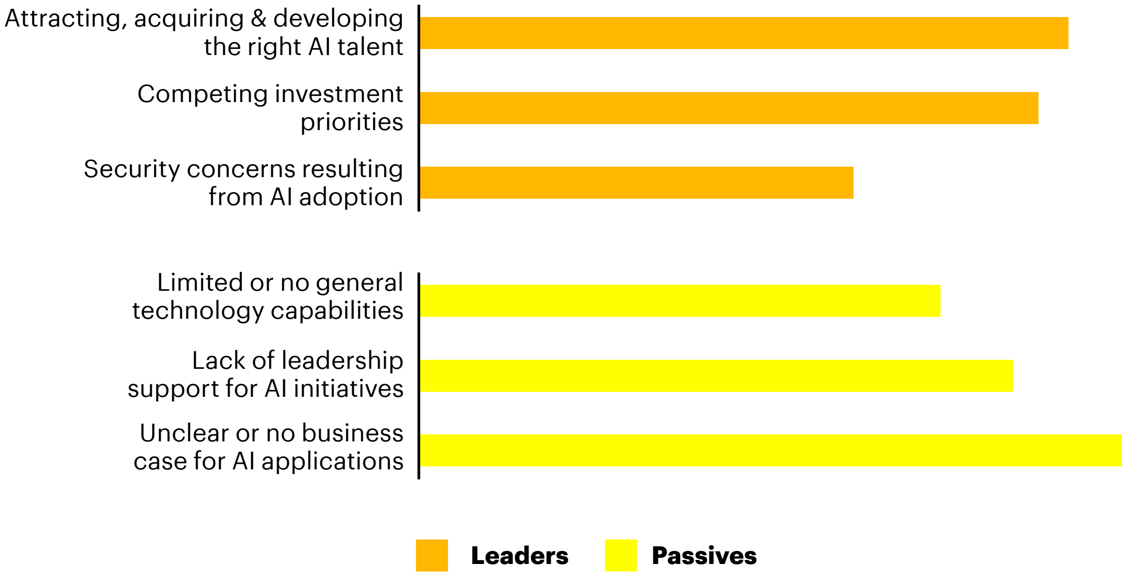
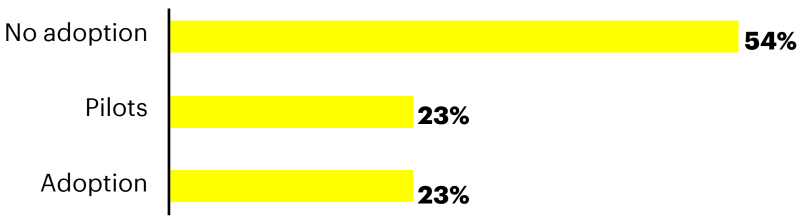


Figure 10 - What is the level of AI adoption in your organisation?[35]



In developing an AI application, an agile “fail fast” approach is invaluable. That means running pilots for each business problem or opportunity to test the feasibility of your solution and assess the technology options available to your organisation.

An appropriate operating model – with Board-level approval – is also essential. In our experience at Accenture, we find creating a central “hub”, or centre of excellence, to provide leadership and governance works best. The hub can then be connected, via a series of “spokes”, to other parts of the business (whether that’s marketing, risk, HR, or others).

This kind of hub-and-spoke model brings some really important benefits to your AI journey:

- It offers economies of scale in selecting the technologies and tools you’ll need, as well as in recruitment and talent development;
- It enables a cross-organisation approach to building and maintaining the necessary data ecosystem;
- It ensures consistency in standards, definitions, and methods, and lets you disseminate best practices across your organisation;
- It provides a rigorous means of measuring value and prioritising opportunities;
- It ensures the highest standards of governance are applied to all your AI projects.

By 2019, 40% of digital transformation programmes and 100% of IoT programmes will be supported by AI capabilities.[36]

IDC



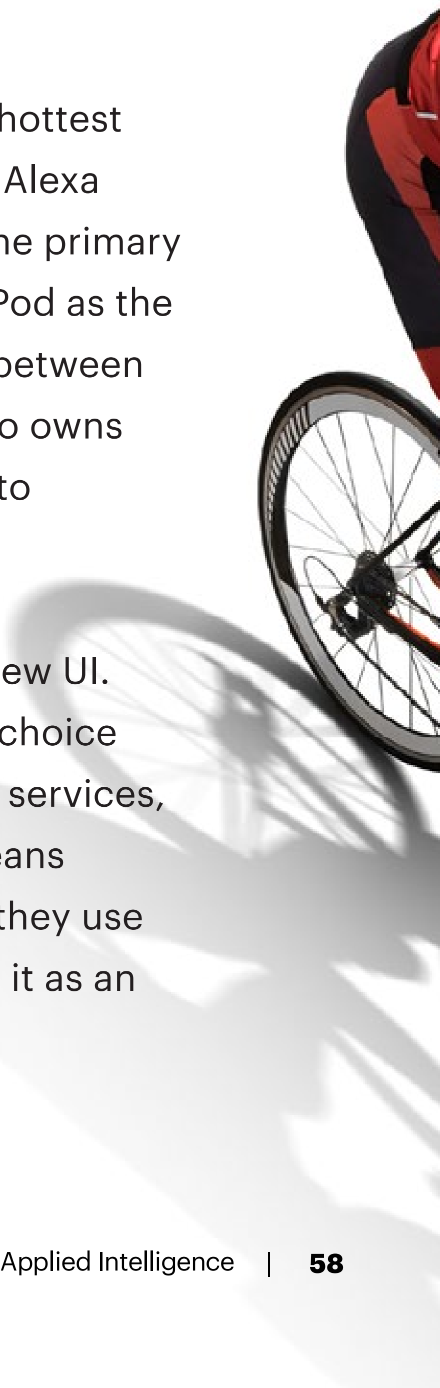
Keeping an eye on the road ahead

As you progress through an AI journey, keeping abreast of the latest innovations and applications is essential. In such a fast-moving landscape, things can change overnight. Knowing what the AI leaders and the AI first-movers are doing – and understanding the implications – will always be a hugely valuable source of business intelligence.

So what might we expect on the road ahead?

In the short term, voice interaction will remain the hottest consumer-facing manifestation of AI. And Amazon Alexa and Google Home will continue their battle to be the primary gatekeeper of the smart home, with Apple's HomePod as the latest entrant. Expect also to see questions raised between platform providers and service providers about who owns what, and who has access to what, when it comes to customer data and relationships.

Voice is part of a more general trend for AI as the new UI. In other words, that AI is becoming the channel of choice for customer interactions, whether that's over chat services, messaging, or smart home devices. Its primacy means organisations must think very carefully about how they use it and how it represents their brand. Those treating it as an afterthought or add-on will quickly come unstuck.



Within 5 years more than half of customers will select services based on a business' AI rather than its traditional brand.[37]

Accenture Technology Vision, 2017



One important implication of this shift is that AI teams must be interdisciplinary, and not simply technical. Microsoft, for example, employs a whole team, including writers and psychologists, to give its operating system AI, Cortana, its unique personality.

Look out, too, for developments in the way brands advertise through devices like the Amazon Echo and Google Home. Voice ads are still very much in their infancy, and a great deal of trial and error is still to come. Interrupting people in their homes to sell them services without being asked will more than likely anger customers. Indeed, Amazon updated its Alexa developer policy in April 2017 to ban all adverts except those in music and flash briefings.[38] So innovative ways to get people coming back to a brand's voice utility will be needed. Quid-pro-quo bargains will likely be struck with customers – their attention in return for something back.

A key point is this: if the state of AI technology isn't already streets ahead of our collective imagination, it soon will be. That makes it very different from previous technology revolutions. What's possible with AI will only be limited by our willingness to experiment – and use it.

75% of business executives say AI will be actively implemented in their companies within three years.[39]

2017 Economist Intelligence Unit Report



EXPLAINABLE AI



The huge opportunities and benefits that AI offers don’t come risk free, of course. What kind of innovation does? But it certainly pays to begin an AI journey with a clear-sighted view of what the risks might be for an organisation.

So, what are they? We think there are four principal risks that must be considered up front. These relate to trust, liability, security, and control:

TRUST

How do we demonstrate to citizens that an AI is safe to use? How do we avoid biases, unconscious or not, being written in from the outset? The answers to these questions lie in transparency and accountability. Decisions taken by an AI must be open to appeal and interrogation.

LIABILITY

What happens when an AI makes an error – or even breaks the law? Who is legally responsible? Changes to legislative and regulatory requirements will need to be monitored carefully.

SECURITY

How do we prevent unauthorised or malicious manipulation of an AI? Security becomes paramount, and is compounded by the increasing use of open source code.

CONTROL

What happens when a machine takes over a process? How does a human take it back if they need to? Careful thought is needed about when and how control is transferred between humans and AIs. For example, it is all very well providing a human riding in a self-driving car with the means to take control but if they are not paying attention 100% of the time, they will be unlikely to intervene fast enough in a critical situation.



72% of executives report that their organisations seek to gain customer trust and confidence by being transparent in their AI-based desicions and actions.[40]

Accenture Technology Vision, 2018

Accenture Launched "Pinterest For AI Education", a new technology platform to train more than 180,000 of its employees globally in the latest digital technologies in just over 20 months. It now plans to use the interactive platform with clients to help develop their IT workforces in critical areas such as digital, cloud, security and artificial intelligence. The Accenture Future Talent Platform integrates learning services and curriculum on as-a-service and mobile platforms to help workforces move away from traditional training and foster a culture of continuous learning.[41]

These issues are something we've given a great deal of thought to at Accenture. Our strong recommendation is to take a "human first" approach to AI thinking. And that means adopting a framework for what we call "Responsible AI". This framework recommends mitigating the risks of using AI with four imperatives: govern; design; monitor; and reskill:

01. GOVERN

Create the right governance framework for AI to flourish. Anchor it to your organisation's core values, ethical guardrails, and accountability frameworks.

02. DESIGN

Build trust into your AI from the outset by accounting for privacy, transparency, and security from the earliest design stage.

03. MONITOR

Audit the performance of your AI against a set of key metrics. Make sure algorithmic accountability, bias, and security metrics are included.

04. RESKILL

Democratise the understanding of AI across your organisation to break down barriers for individuals impacted by the technology.

It's also vital to remember that humans can be susceptible to unconscious bias. And that has big implications when it comes to coding and training an AI and selecting the data sets it will use. This is an area in which general standards may be required. Collectively, we may need to aspire to a higher degree of responsibility from our AIs than we would necessarily demand from human colleagues.

The need to explain

There is one thing above all that will ensure public trust is maintained when an organisation starts using AI: "explainability". In other words, being ready to explain how and why an AI came to the decision it did. This is something that certain regulated industries are already familiar with. Financial services institutions, for example, are required to explain the decisions they take that affect their customers.

But there's also a broader issue here: humans are more likely to trust something they understand. So "explainable AI" becomes a vital part of any AI strategy.

DARPA'S EXPLAINABLE AI CHALLENGE

DARPA, the Defense Advanced Research Projects Agency, has launched an explainable AI (XAI) programme with the goal of creating a suite of machine learning techniques which produce more explainable models. The models will be combined with interfaces capable of translating them into understandable and useful explanations for human users.[42]

In fact, that's easier said than done. Machine learning is often by its very nature a "black box" exercise. In other words, it operates in ways that can make it very hard to explain how it arrived at the outputs it produced. But many AI practitioners and data scientists are thinking about this question, and new approaches offering better explanations of the science underlying AI decisions will likely soon emerge.

In the meantime, there are some practical steps that every business can take now to make their AI more explainable:

01. INVENTORY

Think about the decisions that are or will be taken by AI in your organisation. Which of them would require an explanation – or create an expectation of one? Do they relate, even indirectly, to key areas like employment, recruitment, lending, education, healthcare, housing, inclusion, or safety?

02. ASSESS

Consider any quantitative and qualitative models that are already providing explanations for decisions taken by AI. How are they performing for their intended recipients?

03. DESIGN

Revisit the design principles used for your AI. How could they make the process of making decisions more human-centred and understandable?

04. AUDIT

Review the data. How do you ensure your AI is using data sets that reflect the evolving nature of your workplace?

GET THE BIGGER PICTURE



No person is an island. And no business is either. The actions we take can reverberate way beyond the boundaries of a single organisation. So, given AI's revolutionary potential and far-reaching spill-over effects, the broader societal implications of using it can't be ignored.

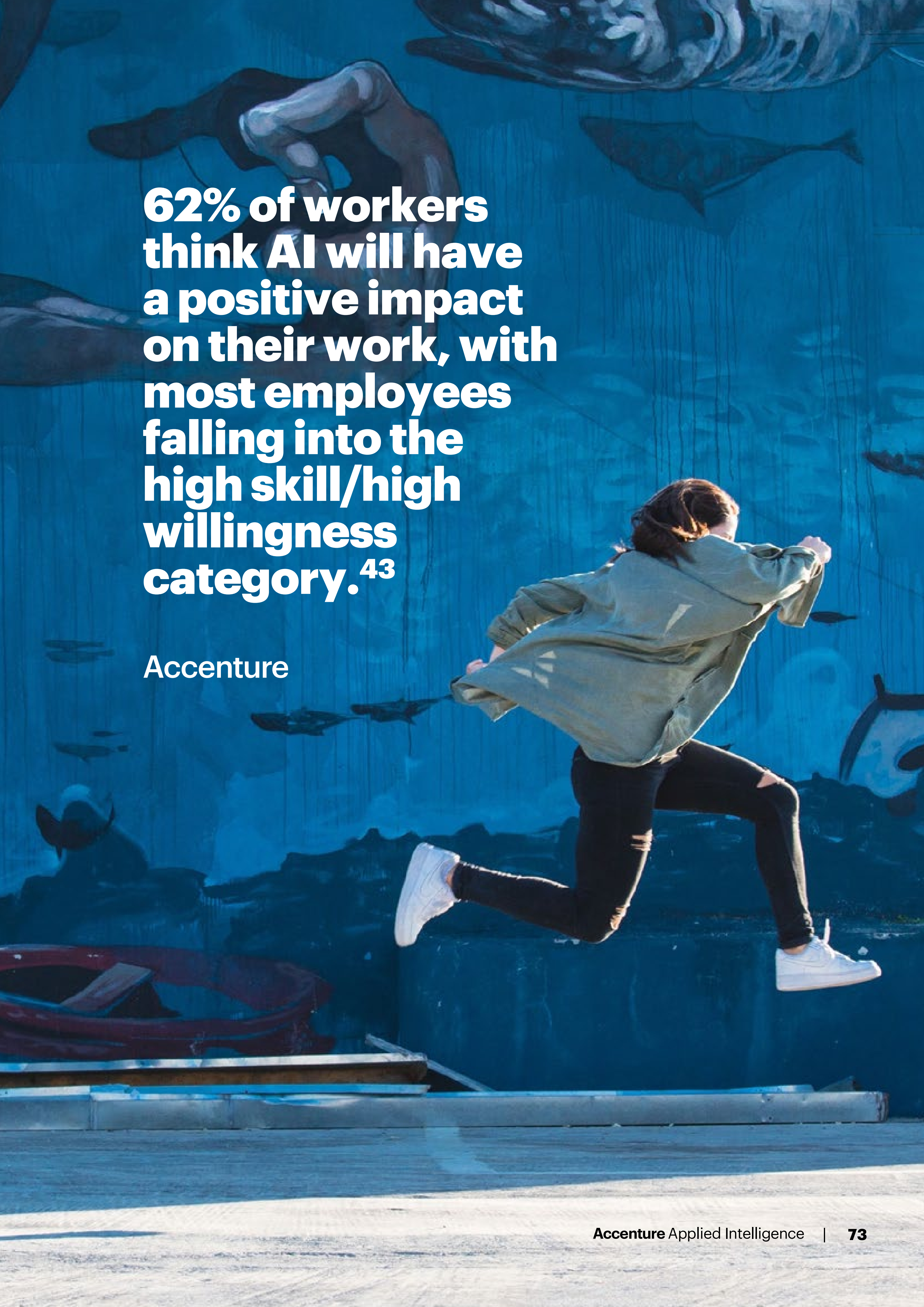
This means collectively addressing some important questions. How do we make sure people have the skills they need to thrive in an AI-driven world? How many existing jobs will AI replace? How many new jobs will be created? Will some people need to find income and fulfilment from sources other than work? What new legal frameworks are needed when AI is taking the decisions? Might humanity even face an existential threat when AIs become more intelligent than their creators?

The skills question

When it comes to skills, governments have for years promoted the uptake of STEM subjects. This must be maintained and accelerated, with the addition of new data and analytics elements into school and training curricula. That shouldn't just apply to STEM subjects either – the importance of data and analytics to other disciplines must be emphasised with equal force. Drives to increase the numbers of apprenticeships, such as that promoted by the UK government, should play a part too.

Industry also has a vital role in upskilling workforces for the AI age, of course. And that will take considerable investment. But businesses have both an economic incentive (to ensure a ready supply of talent) and a moral obligation (to use AI responsibly) to do so. What's more, industry involvement becomes even more vital if the speed of AI-driven change means our existing education and training bodies can't keep pace on their own.

Occupations that require some of humanity's most intrinsic qualities – creativity, empathy, kindness, care – may in any case be some of the last to be affected by AI. There is little chance of an AI replicating these core aspects of human intelligence any time soon. So there will be many important and rewarding career paths which will remain open to people, even if they can't necessarily outsmart the machines.



62% of workers think AI will have a positive impact on their work, with most employees falling into the high skill/high willingness category.[43]

Accenture

The jobs question

Whether AI will ultimately have a positive or negative net impact on employment is a big question, and not one that can be answered in a Pocket Guide. But we at Accenture are broadly optimistic. If organisations can use AI in a responsible and human-centred way, and if they can focus on augmenting human intelligence as much as replacing it, we think the impact will be positive. Approaching AI in this way will allow human workforces to focus on the more interesting, challenging, creative, and interpersonal parts of their jobs – and leave the humdrum, boring, repetitive parts to the machines.

We're not alone in our optimistic outlook. And that's because many people think AI will end up creating more jobs than it destroys. Those that take this view look at the history of previous technology revolutions and see that, in every case, there was ultimately a net increase in overall employment. That increase often skipped a generation, admittedly. So, whereas an older generation of workers might have lost out from the introduction of a new technology, history suggests the next generation benefitted. In the long run, this argument goes, AI will have the same net positive impact.



THE EFFECT OF AUTOMATION ON MANUFACTURING

How has the automation of manufacturing processes impacted employment? You might think the widespread use of industrial robots means there'd be a great deal fewer workers needed today than in the past. Not so, according to a recent report from Germany.

Over the past 20 years, Europe's strongest economy and manufacturing powerhouse has quadrupled the number of robots used in its industries. In 1994, for example, Germany had around 2 industrial robots installed for every thousand workers. By 2014, this had risen to 7.6 robots for each thousand workers (compared to just 1.6 in the US).

In the country's thriving automotive industry, between 60 and 100 additional robots were installed for each thousand workers over that period.

Automation? Close to nil. Researchers from the Universities of Würzburg, Mannheim, and the Düsseldorf Heinrich-Heine University examined 20 years of employment data and found that, despite significant growth in the use of robots, there hadn't been any dent in aggregate German employment: "Once industry structures and demographics are taken into account, we find effects close to zero".[44]

Not everyone is so sanguine, it's true. Such people argue that this time it's different. They point out that, whereas many previous technology revolutions involved the mechanisation of manual labour, AI involves the automation of far more fundamental cognitive processes. So, while mechanical automation might replace a set of specific tasks (tractors replacing horses in agriculture for example), cognitive automation is so broad as to strike at the core competitive advantage of human beings: their ability to think. In the long run, this argument goes, we should brace ourselves for widespread job losses.

With such a broad array of views, a quick resolution to the jobs question is unlikely. The debate will run for some time yet. In the meantime, it is incumbent on both government and industry to make every effort to ensure responsible and human-centred approaches are taken to the use of AI.

"In 2020 AI will create 2.3 million jobs 2017 Economist Intelligence Unit Report whilst eliminating 1.8 million, making 2020 a pivotal year in AI-related employment dynamics."[45]

Gartner

The legal question

There is no doubt that legal and regulatory frameworks will need to evolve as AI takes an ever-greater hold in business, industry, and beyond. One of the first and most pressing areas will likely be the law surrounding autonomous vehicles. Consider legal areas like personal injury, negligence, and tort. Who, for example, will be liable if an autonomous vehicle crashes with no driver at the wheel? The vehicle manufacturer? The software provider? The human occupants?

And, what about the legal implications of AI design? When an autonomous vehicle faces two equally tragic choices (saving the life of its human occupant, say, against saving pedestrians on the street ahead) the AI's design will need a clearly thought-through legal framework for deciding which option to take. This cuts right to the core of some of the most difficult legal and moral questions there are.

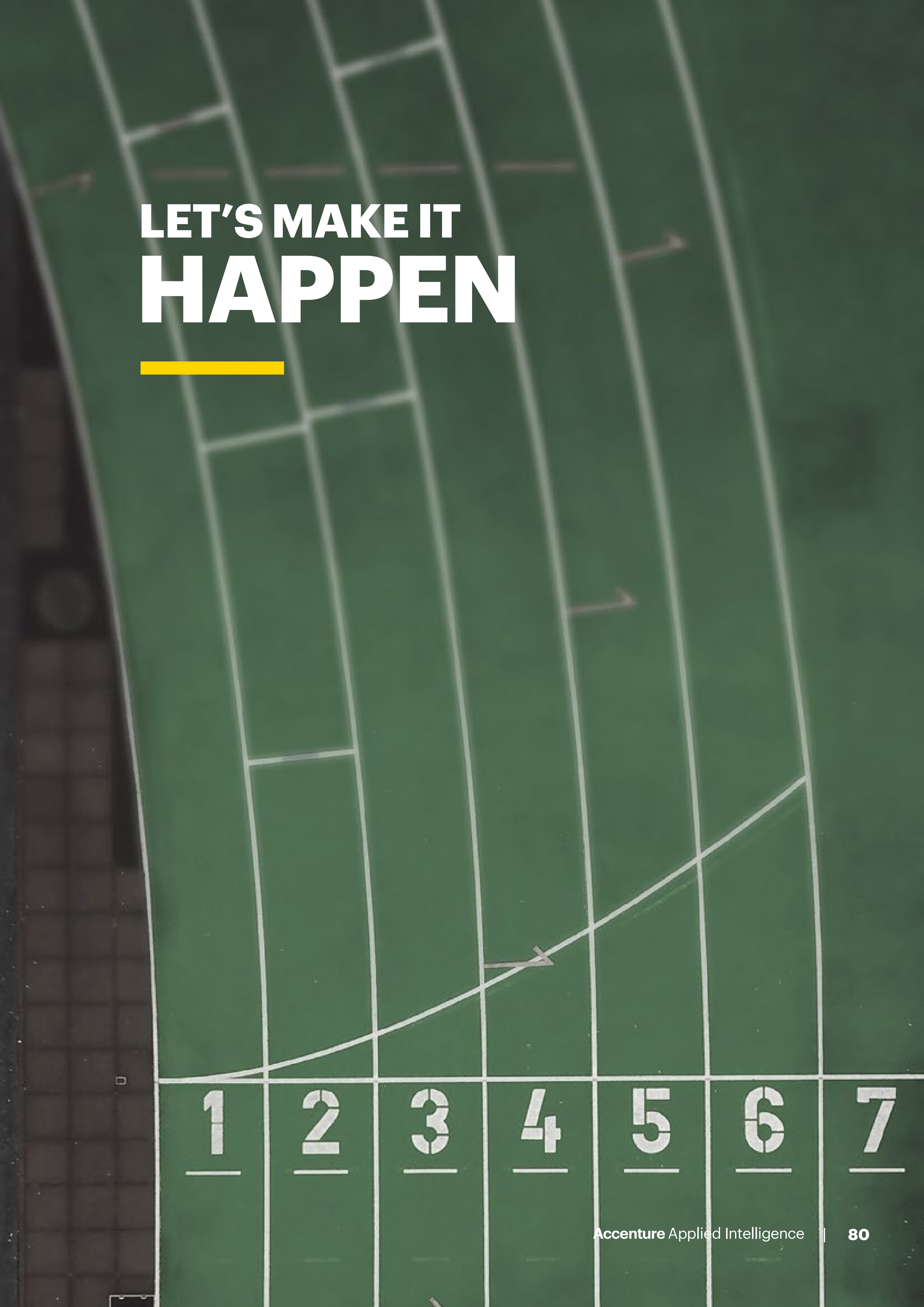
Competition law may well need to adapt too. Pricing algorithms are already widely used by online retailers, enabling much faster and more sophisticated price adjustments. Amazon reputedly changes the prices of some items many times each hour, equating to millions of individual price changes every day.[46] Any decision made by AI in an open marketplace will need to be transparent and explainable.

The existential question

No-one knows for sure whether AIs will ever surpass a human's general intelligence. Even less, what will happen if it does. And among those experts who think general AI is a real possibility, opinions diverge hugely on when it might happen. We feel confident in saying that despite AI's truly amazing potential for humanity, general AI is a long way from being a reality. But that doesn't mean we shouldn't be thinking about its consequences and implications. So the establishment of academic and industry-sponsored bodies to examine the question, such as the Future of Humanity Institute at Oxford University, is a very welcome development.



LET'S MAKE IT HAPPEN



So that's AI. We hope this guide has given you a clear sense of its underlying technologies, its game-changing capabilities, and its potentially revolutionary implications. As it gains critical mass, AI will change forever how we work and how we live.

It's a completely new factor of production, and it's going to drive business growth in important ways, whether by extending automation into previously human-only arenas, augmenting our work to drive new levels of effective decision making, or diffusing exponential levels of innovation through organisations and beyond.



Businesses big and small are already experimenting with AI solutions to drive new growth. They're finding ways to make their workers smarter. They're discovering new kinds of interactions with their customers. And they're starting to build AI machines that can work faster and better than their human counterparts.

Like any radical innovation, there will be risks in starting an AI journey. And there may be unintended consequences along the way. That's why taking a responsible approach to the technology is so important. Trust, transparency, and security must be built into AI design from the outset. And the need to explain must always be front of mind.

In the end the message is simple. AI is here. It's real. And it's time to sit up, take notice, and take advantage.

Recommended Reading

The Second Machine Age by Erik Brynjolfsson and Andrew McAfee
Machine, Platform, Crowd by Erik Brynjolfsson and Andrew McAfee
Life 3.0 by Max Tegmark
Human + Machine: Reimagining Work in the Age of AI by Paul Daugherty & James Wilson (forthcoming March 20th, 2018)
Homo Deus by Yuval Noah Harari
The Quest for Artificial Intelligence by Nils Nilsson
The Master Algorithm by Pedro Domingos
The Future of the Mind by Michio Kaku

I would like to thank Accenture colleagues too numerous to mention for their help formulating the concepts described in this publication; and Lucy Frost, Noor Sajid, Caryn Tan and Alexandra Vernon for their assistance with research and design.

Sources

[1] Nanterme, P. (2016, January 17). Digital Disruption Has Only Just Begun. World Economic Forum. https://www.weforum.org/agenda/2016/01/digital-disruption-has-only-just-begun/

[2] Faggella, D. (2017, August 24). Venture Investments in Artificial Intelligence – Trends in 2016 and Beyond.TechEmergence. https://www.techemergence.com/venture-investments-in-artificial-intelligence-trends/

[3] Hoffman, M. (2016). Artificial Intelligence Patents Growing Exponentially. Hoffman Warnick. http://hoffmanwarnick.com/artificial-intelligence-patents-growing-exponentially/

[4] Hall, W., & Pesenti, J. (2017, October 15). Growing the Artificial Intelligence Industry in the UK. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/652097/Growing_the_artificial_intelligence_industry_in_the_UK.pdf

[5] Wang, R. (2016, September 18). Understanding the Spectrum of Seven Artificial Intelligence Outcomes. R“Ray” Wang. http://blog.softwareinsider.org/2016/09/18/mondays-musings-understand-spectrum -sevenartificial-intelligence-outcomes/

[6] BBC. (2017, May 25). Google AI Defeats Human Go Champion. BBC News. http://www.bbc.co.uk/news/ technology-40042581

[7] Hassabis, D., & Silver, D. (2017, October 18). AlphaGo Zero: Learning from Scratch. DeepMind. https://deepmind.com/blog/alphago-zero-learning-scratch/

[8] Schaeffer, J. (2018, January 12). Techmate: How AI Rewrote the Rules of Chess. Financial Times. https://www.ft.com/content/ea707a24-f6b7-11e7-8715-e94187b3017e

[9] Brynjolfsson, E., & McAfee, A. (2017, July). The business of Artificial Intelligence. Harvard Business Review. https://hbr.org/cover-story/2017/07/the-business-of-artificial-intelligence

[10] Gartner. (2010). Gartner Customer 360 Summit 2011. Gartner Summits. https://www.gartner.com/imagesrv/summits/docs/na/customer-360/C360_2011_brochure_FINAL.pdf

[11] Clarifai. (2016, April 19). Animals vs. Food vs. A.I. https://crimesagainstai.com/2016/04/19/animals-vs-food-vs-a-i/

[12] Grosse, R., Lee, H., Ng, A., & Ranganath, R. (2011, October). Unsupervised Learning of Hierarchical Representations with Convolutional Deep Belief Networks. https://www.cs.princeton.edu/~rajeshr/papers/cacm2011-researchHighlights-convDBN.pdf

[13] Antonoglou, I., Graves, A., Kavukcuoglu, K., Mnih, V., Riedmiller, M., Silver, D., & Wierstra, D. (2013, January 1). Playing Atari with Deep Reinforcement Learning. DeepMind Technologies. https://deepmind.com/research/publications/playing-atari-deep-reinforcement-learning/

[14] West, J. (2016, April 2). Microsoft's Disastrous Tay Experiment Shows the Hidden Danger of AI. Quartz. https://qz.com/653084/microsofts-disastrous-tay-experiment-shows-the-hidden-dangers-of-ai/

[15] Hopkins, B., McCormick, J., & Schadler, T. (2016, July 27). Insights-Driven Businesses Will Take $1.2 Trillion a Year by 2020. Forrester. https://www.forrester.com/InsightsDriven+Businesses+Will+Take+12+Trillion+A+Year+By+2020/-/E-PRE9365

[16] Transparency Market Research. (2016, November 4). Global IT Robotic Automation Market. https://www.transparencymarketresearch.com/it-robotic-automation-market.html

[17] Gallup. (2017). "Few U.S. Workers Worry About Tech Making Their Job Obsolete" p.2, August 2-6, 2017. Retrieved from http://news.gallup.com/poll/216116/few-workers-worry-tech-making-job-obsolete.aspx?g_source=workplace+satisfaction&g_medium=search&g_ campaign=tiles

[18] Crevier, D. (1993). AI: The Tumultuous Search for Artificial Intelligence. New York: Basic Books.

[19] Sato, K. (2017, May 12). An In-depth Look at Google's First Tensor Processing Unit (TPU). Google Cloud Platform. https://cloud.google.com/blog/big-data/2017/05/an-in-depth-look-at-googles-first-tensor-processing-unit-tpu

[20] Klein, A. (2017, July 11). Hard Drive Cost Per Gigabyte. Blackblaze. https://www.backblaze.com/blog/hard-drive-cost-per-gigabyte/

[21] Kelnar, D. (2017). The State of AI 2017: Inflection Point. MMC Ventures. https://www.mmcventures.com/wp-content/uploads/2017/10/The-State-of-AI-2017-Inflection-Point-Summary.pdf

[22] Revell, T. (2017, May 31). AI Will be Able to Beat us at Everything by 2060, Say Expert. New Scientist. https:// www.newscientist.com/article/2133188-ai-will-be-able-to-beat-us-at-everything-by-2060-say-experts/

[23] Etzioni, O. (2016, September 20). No, the Experts Don't Think Superintelligent AI is a Threat to Humanity. MIT Technology Review. https://www.technologyreview.com/s/602410/no-the-experts-dont-think-superintelligent-ai-is-a-threat-to-humanity/

[24] Berlucchi, M. et.al. (n.d.). Artificial Intelligence in the Real World. The Economist. https://www.eiuperspectives.economist.com/sites/default/files/Artificial_intelligence_in_the_real_world_1.pdf

[25] Robots for Recycling. (2017). https://www.amprobotics.com/

[26] Lant, K. (2017, May 5). Confirmed: AI Can Predict Heart Attacks and Strokes More Accurately Than Doctors. Futurism. https://futurism.com/ confirmed-ai-can-predict-heart-attacks-and-strokes-more-accurately-than-doctors/

[27] Accenture Technology Vision. (2018). Redefine Your Company Based on the Company You Keep: Intelligent Enterprise Unleashed. https://www.accenture.com/t20180208T172438Z__w__/us-en/_acnmedia/Accenture/next-gen-7/tech-vision-2018/pdf/Accenture-TechVision-2018-Tech-Trends-Report.pdf

[28] Accenture. (2018). Avianca Airlines New Chatbot is Reducing Travel Stress, One Passenger at a Time. https://www.accenture.com/gb-en/success-avianca-airlines-new-chatbot-reducing-travel-stress

[29] Gregory, J. (2017, July 6). Press Association Wins Google Grant to Run News Service Written by Computers. The Guardian. https://www.theguardian.com/technology/2017/jul/06/press-association-wins-google-grant-to-run-news-service-written-by-computers

[30] Lee, J. (2015, April 24). GTRIIP Provides Biometric Identification Solution for Hotel Check-In. Biometric Update. http://www.biometricupdate.com/201504/gtriip-provides-biometric-identification-solution-for-hotel-check-in

[31] World Economic Forum. (n.d.). The Driverless Car Revolution. http://reports.weforum.org/digital-transformation/the-driverless-car-revolution/

[32] Lovett, L. (2017, December 4). Accenture's Latest AI Platform to Help Seniors with Loneliness Wraps up Pilot Program. MobiHealthNews.
http://www.mobihealthnews.com/content/accentures-latest-ai-platform-help-seniors-loneliness-wraps-pilot-program

[33] Leonard, S., (2014, January 23) .Smart Tissue Anastomosis Robot (STAR): A Vision-Guided Robotics System for Laparoscopic Suturing. http://ieeexplore.ieee.org/abstract/document/6720152/?reload=true

[34] Ransbotham, R., Kiron D., Gerbert, P., & Reeves, M. (2017, September 6). Reshaping Business with Artificial Intelligence. MITSloan Management Review. https://sloanreview.mit.edu/projects/reshaping-business-with-artificial-intelligence/

[35] Ransbotham, R., Kiron D., Gerbert, P., & Reeves, M. (2017, September 6). Reshaping Business with Artificial Intelligence. MITSloan Management Review. https://sloanreview.mit.edu/projects/reshaping-business-with-artificial-intelligence/

[36] Fitzgerald, S., and Parker, R. (2017, November 1). IDC Reveals Worldwide Digital Transformation Predictions. International Data Corporation. https://www.idc.com/getdoc.jsp?containerId=prUS43188017

[37] Accenture Technology Vision. (2017). Technology for People: The Era of the Intelligent Enterprise. https://www.accenture.com/t20170530T164033Z__w__/us-en/_acnmedia/Accenture/next-gen-4/tech-vision-2017/pdf/Accenture-TV17-Full.pdf

[38] Perez, S. (2017, April 20). Amazon's New Alexa Developer Policy Now Bans ALL Ads Except in Music and Flash Briefings. TechCrunch. https://techcrunch.com/2017/04/20/amazons-new-alexa-developer-policy-now-bans-all-ads-except-in-music-and-flash-briefings/

[39] Kelnar, D. (2017). The State of AI 2017: Inflection Point. MMC Ventures. https://www.mmcventures.com/wp-content/uploads/2017/10/The-State-of-AI-2017-Inflection-Point-Summary.pdf

[40] Accenture Technology Vision. (2018). Redefine Your Company Based on the Company You Keep: Intelligent Enterprise Unleashed. https://www.accenture.com/t20180208T172438Z__w__/us-en/_acmedia/Accenture/next-gen-7/tech-vision-2018/pdf/Accenture-TechVision-2018-Tech-Trends-Report.pdf

[41] Which.(2017, November 20) Accenture Launches Pinterest for Education. Which-50. https://which-50.com/accenture-launches-pinterest-ai-education/

[42] "Gunning, G.(n.d) Explainable Artificial Intelligence. DARPA. https://www.darpa.mil/program/explainable-artificial-intelligence"

[43] Accenture. (2017). Harnessing the Revolution, Creating the Future Workforce. https://www.accenture.com/us-en/_ acnmedia/A2F06B52B774493BBBA35EA27BCDFCE7.pdf

[44] Vox. (2017, September 19) The rise of robots in the German labour market. https://voxeu.org/article/rise-robots-german-labour-market

[45] Gartner. (2017, December 13). https://www.gartner.com/newsroom/id/3837763

[46] D'Onfro, J., (2015, January 13) The Clever Way Amazon Gets Away with Not Always offering the Lowest Prices. http://uk.businessinsider.com/how-amazon-adjusts-its-prices-2015-1

About Accenture

Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Combining unmatched experience and specialized skills across more than 40 industries and all business functions – underpinned by the world's largest delivery network – Accenture works at the intersection of business and technology to help clients improve their performance and create sustainable value for their stakeholders. With approximately 449,000 people serving clients in more than 120 countries, Accenture drives innovation to improve the way the world works and lives.
Visit us at www.accenture.com.

Applied Intelligence

Accenture Applied Intelligence, part of Accenture Digital, applies artificial intelligence (AI) and human ingenuity at the core of business to help clients become intelligent enterprises and solve their most complex business problems. By deploying AI responsibly and combining it with our deep industry and analytics expertise, we enable the digital transformation of organisations, extend human capabilities, and make intelligent products and services a reality.

Follow @AccentureAI and visit accenture.com/appliedintelligence.